HOLIDAYS AND THE TIMING OF BIRTHS IN THE UNITED STATES

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ABSTRACT

Background

The growing acceptance of cesarean delivery and the use of inductions for medical purposes may also have permitted births to be moved off weekends and holidays and onto weekdays. The magnitude of this effect is unclear, as are the correlates of which births are actually moved.

Methods

We use birth records from the United States from 1973-99 to study the frequency of births that occurred on weekdays and major holidays. Using microdata for the 1998 birth cohort (n=3,734,051) we perform multivariate logistic regression to quantify the correlates of which births are moved off holidays.

Results

In 1999, the number of births occurring on a weekend or weekday holiday was 35% less than those occurring on a non-holiday weekday. The extent to which births are timed away from weekend and holidays has grown dramatically over time. Multivariate analysis demonstrates that relatively healthy babies as measured by birthweight, mother's SES and prenatal care are most likely to be moved, but that those with risk factors and congenital anomalies are less likely to be born on weekends.

Conclusions

The timing of births has significantly increased in the past three decades to avoid births occurring on weekends and holidays. Less risky births (as measured by birthweight, prenatal care, age and socio-economic status of the mother) are more likely to be timed for weekdays. Therefore, studies that find that weekend mortality is higher than weekday mortality should be cautious before concluding that low staffing levels on weekends are the causal factor; the compositional effect of healthy babies being moved away from weekends is an important concomitant factor. Further research is needed to understand the consequences of this movement for infant health.

In the United States the proportion of all births that are vaginal and performed *without* the use of inducement or stimulation has been decreasing over time. The growing acceptance of cesarean deliveries and the induction of labor has contributed to this decline. For example, in 2000, 22 percent of all live births were cesarean deliveries and the primary cesarean rate was 16 percent.[1] Similarly, the fraction of all births in which labor was either induced or stimulated increased from 20 percent in 1989 to 35 percent in 1997.[2] While the principal purpose of both interventions is to improve health outcomes for mothers and babies, it is also possible that both technologies are increasingly being used to move births away from weekends and holidays and onto weekdays.

There are several reasons for why the movement towards "designer birthdays" might occur: obstetricians may be responding to reduced staffing levels on weekends, or they may have stronger preferences to not work on holidays since physicians do not receive additional payments for working on a holiday. These effects may be reinforced by parental preferences for a weekday birth (although it should be stressed that ultimately it is the physician who must perform the caesarian or inducement). For example, previous work from the economics literature has found a pronounced relationship between the tax incentives from having a late December birth and the movement of births from early January to late December by families who would benefit from such timing.[3] Regardless of the underlying motivation, as long as a factor other than the wellbeing of the infant or mother affects the timing of births, physicians ought to be concerned about the increased risks that any medical intervention places on the patient.

In this paper, we make two contributions: First, we build on previous work by documenting the extent to which births on holidays, including weekends, are now timed for weekdays. We use the universe of all reported live births in the United States. Previous research has relied on non US, hospital specific data, that can be highly idiosyncratic depending on the country and teaching status of the hospital.[4] [5] [6] [7] If the purpose of this movement is primarily for medical reasons, the distribution of births within week should be uniformly distributed, since the incidence of medical complications should not be connected to day of week. Contrary to this expectation, we find that the number of births that occur on weekends and holidays has been declining radically over time. Our results therefore suggest that a combination of factors including patient and physician "demand for leisure," as well differences in staffing levels across weekdays and weekends, contribute to the shifting of births. This result is not driven by the use of scheduled procedures such as Vaginal Births After Cesarean (VBAC) or Repeat Caesarians, since when we restrict our sample to only first-births (where VBAC or Repeat Caesareans are not impossible) we obtain identical patterns to when they are included.

Our second contribution is to examine the correlates of which babies are being shifted off holidays. Here again, we note that, in general, it is not the higher-risk births (as might be the case if babies were being moved for medical reasons). Indeed, through the use of multivariate logistic regression we find that low-risk, heavier babies, those with adequate pre-natal care, more educated mothers, non-smoker mothers, non-drinker mothers are all *more likely to be born on a weekday*. This finding confirms the view that much of the movement away from holidays and onto weekdays is motivated by non-medical factors. Furthermore, as we discuss in the paper, this result also demonstrates that it is through a large compositional effect that weekend outcomes are observed to be worse than weekday outcomes. Therefore, the view that reduced staffing-levels on weekends is the dominant factor in contributing to worse outcomes for infants born on weekends requires refinement.[8]

METHODS

Data

We use data from reported live births in the United States. The US shares the same definition of live births as the WHO,[9] and US law mandates that the registration of births is the responsibility of the attendant at birth, or, in that persons absence, the parents of the child.[10] The Natality data are limited to births occurring within the United States, including those occurring to U.S. residents and nonresidents. In recent years, approximately 99 percent of all births occurring in the United States are registered.

For the years 1973-1988, we use the natality detail files to compute daily counts of births occurring. Starting in 1989, the actual date of birth is suppressed in the natality detail files, but the National Center for Health Statistics (NCHS) reports tabulations of the daily count of live births that occurred. According to the NCHS, it is only in 1985 that all states and the District of Columbia participated in the Vital Statistics Cooperative Program (VSCP).[11]

Statistical Analysis

We report the daily count of the number of births that occurred from January 1990-December 1999. To understand the extent to which the timing of births has changed over time, we construct an "index of occurrence" which controls for the fact that different years have varying numbers of specific days of the week. This index is defined as the ratio of the average number of births for a given day of the week to the average daily number of births. To illustrate, assume that there were 4 million births in a year with 365 days. This would imply a daily average count of births 10,959 births. If in that year Christmas Day had only 8,000 births, the index of occurrence for Christmas Day would be (8000/10959)= 0.73. In words, Christmas Day has 73 percent of the number of births that one would expect, were there no movement. The advantage of using this index is that is accounts of yearly variation in the number of Sundays or Mondays in a given year. Additionally, since for the 1973-1985 period we only have a sample of total births, the use of an index of occurrence overcomes the problems that would be evident if we studied raw counts.

To understand the correlates of which births are moved, we estimate multivariate logistic regression models and report odds ratios. All analyses were performed in Stata 7.0.

Samples and Definitions

For the multivariate logistic models, we use the 1998 detailed natality files from the NCHS and restrict our sample to those births that occurred in the 50 US States and Washington DC. Furthermore, we restrict our analysis sample to all birth certificates with non-imputed values of birth weight and gestation, those without multiple pluralities, and those that had valid codes for congenital anomalies, complications of labor and delivery, obstetric procedure used, and medical risk factors [n=3,734,051]. Our analysis is robust to each of these sample inclusion criteria.

For states that do not report tobacco and alcohol use or weight gain during pregnancy (California, New York State; not New York City) we include indicator variables to represent missing values of these variables. We define the adequacy of prenatal care using a three-point Kessner index. We use standard definitions of risk factors and congenital anomalies, as coded in the natality detailed files. Specifically, with binary variables we define:

Risk-factors: whether there was anemia, cardiac disease, acute or chronic lung cancer diabetes, genital herpes, hydraamnios or oligohydramnios, hemoglobinathy, chronic hypertension, pregnancy-related hypertension, eclampsia, incompetent cervix, previous infant over 4000gms, previous preterm infant, renal disease, Rh sensitization, uterine bleeding or other (non-specific risk) factors. Variables were also included to measure the exact amount of tobacco and cigarette consumption as well as weight gain during pregnancy.

Congenital Anomalies: Anencephalus, Spina bifida/meningocele, Hydrocephalus, Microcephalus, Other central nervous system anomalies, Heart malformations, Other circulatory/respiratory anomalies, Rectal atresia/stenosis, Tracheo-esophageal fistula/Esophageal atresia, Omphalocele/gastroschisis, Malformed genitalia, Renal agenesis, Other urogenital anomalies, Cleft lip/palate, Polydactyly/syndactyly/adactyly, Club foot, Diaphragmatic hernia, Musculoskeletal/integumental anomalies, Down's syndrome, Other chromosomal anomalies.

RESULTS

Evidence from Weekends and Holidays

In Figures 1 and 2 we display the daily count of births from January 1, 1990 to December 31, 1999 and highlight holidays in red. In Figure 1 we demonstrate the extent to which there is considerable within week timing of births in a manner that would not be predicted by a simple biological model. Each yellow dot measures the daily count of the number of babies born on a particular day over a 10-year period from 1990-1999, and we have highlighted the count on different days of the week with red dots. It is clearly evident that the number of babies born on a weekend is almost 30 percent less than the average weekday count. However, all weekend days and weekdays are not alike: Sundays have fewer babies than Saturdays, and Mondays have fewer births than other weekdays.

In Figure 2, we highlight four major holidays: Labor Day Monday, Memorial Day Monday, Thanksgiving Thursday, July 4th, Christmas Eve and Christmas Day. For the first three holidays, the horizontal line is the expected number of births for that day. For example, since Labor Day Monday and Memorial Day Monday are both Mondays, we graph the Monday average. In the Thanksgiving Thursday graph, the horizontal line is the Thursday average count. The figure clearly demonstrates that holidays that fall on weekdays have daily birth counts that are identical to those for weekends. Since the next three holidays-- July 4th, Dec 25th and Dec 25th-- can fall on any day of the week, the horizontal lines measure the average number of births across the week. Note that the lowest daily count of births in the entire year occurs on Christmas Day. The cyclical behavior that is observed for Christmas Eve is a function of the day that Christmas Day falls on: if Christmas Day falls on a Friday or Tuesday, the number of births on Christmas Eve is very also low, since one can now make use of a four-day weekend.

Evidence from Trends over Time

To illustrate the increasing prevalence of timing births over time, we report the *index of occurrence* for weekends and holidays from 1973 to 1999 in Table 1. The first two columns report the extent to which the number of births on non-holiday weekdays has increased over time, a trend that is driven by the simultaneous decline in non-holiday weekend births. In 1973, such days had 10 percent fewer births than what would be predicted from a biological distribution in which births were uniformly distributed. By 1999, such days had 25 percent fewer births. Similar trends are also seen for other major holidays in the United States, including Christmas Eve and Christmas Day, the Thursday and Friday of Thanksgiving weekend, and perhaps most interestingly, even Super Bowl Sunday (to allow for a meaningful comparison for this day, we also compute an index of occurrence for all Sundays in the year in the last column). Of all the holidays considered in this table, Christmas Day and Thanksgiving Thursday are clearly the most undesirable days on which to have a birth-- by 1999, the number of births occurring on Dec 25th was almost 40 percent less than what a biological distribution would predict.

While not reported we also computed the Index of Occurrence for other holidays such as President's Day and Martin Luther King Day and obtained similar results. Furthermore, we have replicated the entire analysis by computing a "local" index of occurrence to account for the fact that several of the holidays (Thanksgiving and Christmas) considered in Table 1 occur at a point of generally low births in the year. We computed this index by restricting the analysis to a two week window centered on the relevant holiday and then computing the index of occurrence. Our results are completely robust to this alternative definition-- as Figure 2 demonstrates, even though there are relatively fewer births occurring in late November and December, the actual number of births on Thanksgiving Thursday and Christmas Day is still significantly lower than the local trend.

The Technology of Birth

Table 2 studies the relationship between five mutually exclusive technologies of birth and the day of week. In Panel A we report the distribution of each technology over the entire week, and in Panel B we report the distribution of technology for a given day of the week. We separate primary cesarean deliveries into those with inducement and those without because the likely cause of the first group is a failed induction. The first row in Panel A reports the within-week distribution of all vaginal births that were neither induced nor stimulated. The number of such births is much higher on weekdays than weekends (14.9 percent versus 12.7 percent). This result is supportive of the interpretation that many births that ought to be delivered as vaginal (without inducement or stimulation) are converted to vaginal births with inducement or stimulation, or perhaps even more aggressively, to cesarean deliveries. Note that the fraction of these (assisted) births is dramatically higher on Mondays to Fridays than the weekend.

As can be seen in Panel A, Tuesdays are the busiest day in the week for births to occur and Mondays are the least busy weekday. This is primarily because of the number of elevated numbers of vaginal--induced and primary caesarian births that occur on Tuesday.

The reason that Mondays comprise the lowest number of births is because few babies were induced on Sunday. Since there is a considerable delay between the administration of Pitocin and actual delivery, babies induced on Monday will only get delivered on Tuesday. Clearly, the convenience factor plays an important role in the timing of cesarean births. [12] [13]

Panel A also demonstrates that procedures that are typically scheduled in advance such as Repeat Cesareans and VBAC deliveries are usually planned for weekdays. In Panel B we study the use of these different technologies for a given day of the week. Of note in Panel B is the large extent to which vaginal, not induced births constitute the dominant group of births on weekends. This occurs because all the other forms of birth can be scheduled away from weekends, thereby increasing the fraction of all births that are vaginal (not induced, or stimulated) on weekends.

In Panel C we report the average birth weight for each of the technology and day of week cells. Panel C demonstrates that weekend babies are significantly much lighter than weekday babies ($p<0.000$), implying that relatively heavier neonates are moved away from weekends. This pattern can also be seen to hold true for any given technology of birth. To the extent that birthweight is positively correlated with infant health,[14] [15] this key finding reveals that on average it is the heavier, or alternatively healthier babies, whose births are being timed for the weekday. The extent to which this result is robust to more control variables is the subject of the next section.

Multivariate Analysis

In Table 3 we analyze differences between the births that occurred on weekdays and those that occurred on weekends. The first two columns demonstrate that for many characteristics, including birth weight, mother's race, mother's schooling, marital status, smoking and drinking behavior during pregnancy, weight gain and gestation, weekend births are less healthy than weekday births. However, births with risk-factors and congenital anomalies are more likely to be scheduled for weekdays. All these differences are found to be statistically significant at the 5 percent significance level.

Next, using a multivariate logistic regression model we present adjusted odds ratios with 95 percent confidence intervals. We perform separate analysis for all births and first births to account for the fact that in the case of first births, repeat cesareans and VBAC procedures are not possible. By limiting the sample to first births only, we can be sure that our results are not being driven by births that are being scheduled for repeat cesarean or VBAC (births that may be risky for health related reasons). The results of the multivariate analysis confirm that the results from the unadjusted means are correct. Second births or those with higher order are more likely to be weekday births than first births [OR for second birth= 1.14; 95 percent CI, 1.14-1.15]. Very Low birth weight infants (VLBW) and Low Birth Weight (LBW) infants and are less likely to be weekday births relative to infants who weigh over 2500 grams [OR=0.90, 95 percent CI, 0.87-0.92] and [OR=0.95, 95 percent CI, 0.94-0.96] respectively. Similarly, black mothers and other minorities are also more like to be weekend births. As mother's SES increases (as measured by education), the odds of a weekday birth increase significantly. Drinking during pregnancy, low levels of weight gain, prenatal care, and gestation all contribute to increasing the odds of a weekend birth. Confirming the results of the unadjusted analysis, it is only those births with a risk factor or congenital anomaly present, which increase the probability of a weekday birth.

Discussion

The timing of births has significantly increased in the past three decades to avoid births occurring on weekends and holidays. Less risky births (as measured by birthweight, prenatal care, age and socio-economic status of the mother) are more likely to be timed for weekdays. If births were being shifted for medical reasons, we would have expected weekday births to be significantly less healthy than weekend births. While there is some evidence in support of this interpretation, for the most part, we find that on average relatively less risky births are more likely to be moved implying that births are being shifted for non-medical reasons. One implication of this finding is that weekend births will be found to have higher mortality and morbidity rates simply because of the compositional effect of shifting health births from the weekend to the weekday. Therefore, studies that find that weekend mortality is higher than weekday mortality should be cautious before concluding that low staffing levels on weekends are the sole causal factor; the compositional effect of moving healthy babies away from weekends is an important concomitant factor. We emphasize that nothing in our study refutes the argument that lower staffing on weekends raises weekend mortality. Indeed, this may certainly be the case, but to attribute the entire magnitude of the weekend-weekday mortality gap to staffing levels would overstate the case.

There is evidence that the reporting of obstetric procedures is understated. Induction of labor is known to be understated.[16] [17] Similarly, a Georgia that linked all birth certificates for a given mother found that VBACs are understated.[18] Biases of this nature will cause our analysis to understate the relationship between the use of obstetric procedure and the timing of births. Another source of bias that has remained unstudied is the extent to which physicians may be checking off risk factors on the birth certificate in order to justify the use of an elective induction or cesarean. This would be especially true of risk factors that are determined discretionarily such as maternal hypertension, febrile fetus, or dystocia, were checked.

The enormous extent to which births are scheduled raises immediate questions for maternal and infant well being. The American College of Obstetrics and Gynecology (ACOG) officially discourages inducing labor for convenience purposes [19] and, in a recent article, Rayburn and Zhang (2002) argue that "[D]ata to support or refute the benefits of … elective inductions are limited."[20] Clearly, for most healthy infants moving a birth by a few days will not result in deleterious outcomes. However, given that cesarean delivery involves major surgery and that contractions from inducement are especially severe (and may even lead to a caesarian delivery being performed because of a failed induction), a more careful analysis of the consequences of timing births for convenience reasons is clearly motivated.[21]

Finally, future research should examine whether academic medical centers are less likely to move births. The availability of residents and perhaps a greater unwillingness to interfere with the natural birth process may make teaching hospitals protective of the tendency to move births for convenience. Finally, it is of critical importance to separate the extent to which moving births for non-medical reasons is a consequence of physician or patient preferences.

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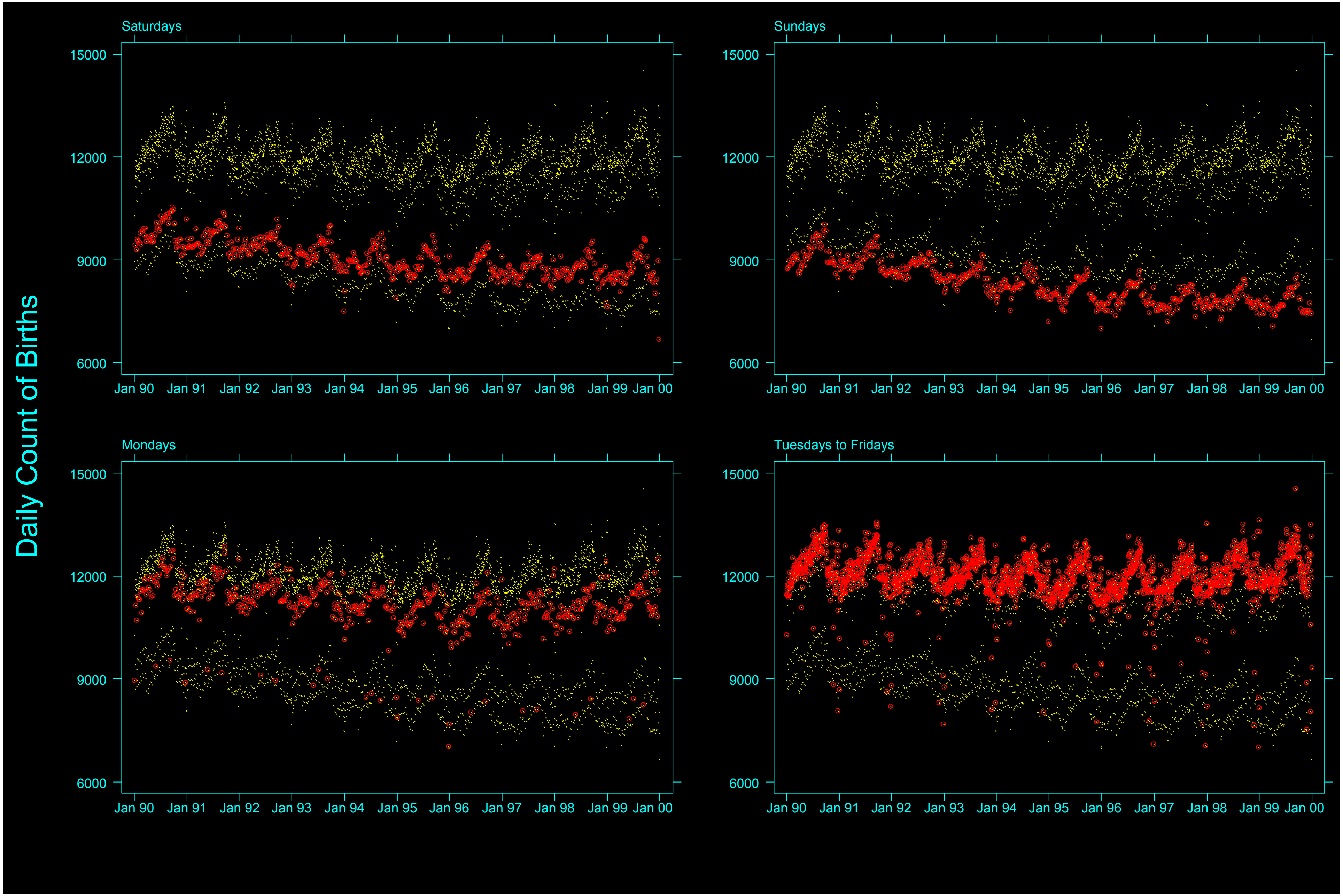

Figure 1: Daily Count of Births, January 1, 1990-December 31 1999. Each panel highlights births occurring on different days of the week. Counts are computed from US Vital Statistics Data using birth certificates for every live birth.

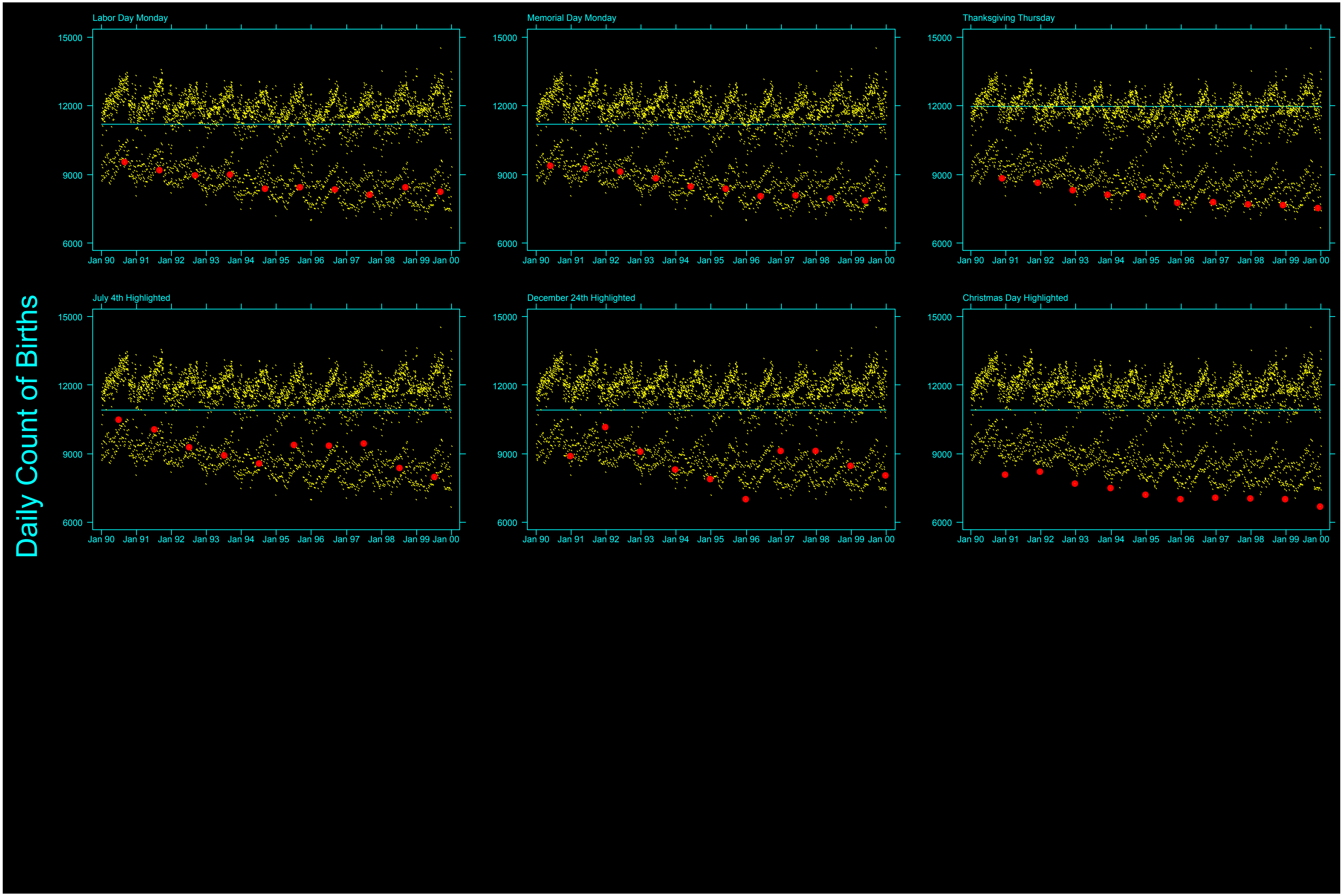

Figure 2: Daily Count of Births, January 1, 1990-December 31 1999. Each panel highlights births occurring on different holidays. Counts are computed from US Vital Statistics Data using birth certificates for every live birth.

Table 1: Incidence of Occurrence for Weekdays, Weekends, and Selected Holidays, for Live Births occurring between January 1, 1990-December 31 1999

Year	Non-Holiday Weekday	Non-Holiday Weekend	Dec 24	Dec 25	Jan 1	July 4	Thanksgiving Thursday	Thanksgiving Friday	Labor Day	Memorial Day	Super Bowl Sunday	All Sundays
1973	1.047	0.901	0.837	0.806	0.854	0.922	0.821	0.953	0.903	0.853	0.880	0.870
1974	1.049	0.898	0.867	0.784	0.806	0.918	0.836	0.972	0.914	0.859	0.854	0.864
1975	1.049	0.894	0.898	0.825	0.823	0.915	0.845	0.974	0.903	0.875	0.837	0.865
1976	1.049	0.897	0.862	0.831	0.844	0.905	0.869	1.004	0.935	0.873	0.828	0.873
1977	1.051	0.888	0.802	0.811	0.815	0.891	0.841	0.953	0.912	0.844	0.837	0.864
1978	1.051	0.892	0.870	0.856	0.844	0.919	0.864	0.988	0.928	0.855	0.848	0.869
1979	1.050	0.893	0.879	0.828	0.859	0.909	0.847	0.986	0.940	0.871	0.839	0.873
1980	1.051	0.891	0.909	0.810	0.832	0.928	0.824	0.972	0.923	0.879	0.860	0.875
1981	1.054	0.881	0.874	0.803	0.835	0.903	0.818	0.969	0.923	0.888	0.843	0.867
1982	1.044	0.904	0.823	0.785	0.834	0.887	0.873	0.877	0.920	0.883	0.851	0.870
1983	1.057	0.871	0.808	0.763	0.820	0.895	0.832	0.940	0.876	0.868	0.872	0.855
1984	1.062	0.868	0.847	0.779	0.799	0.919	0.795	0.970	0.924	0.833	0.804	0.849
1985	1.064	0.860	0.892	0.779	0.808	0.890	0.793	0.962	0.890	0.877	0.809	0.841
1986	1.069	0.848	0.883	0.787	0.820	0.875	0.778	0.944	0.868	0.858	0.808	0.827
1987	1.071	0.841	0.854	0.754	0.799	0.848	0.796	0.959	0.893	0.841	0.798	0.819
1988	1.070	0.843	0.776	0.733	0.794	0.866	0.797	0.944	0.869	0.865	0.796	0.819
1989	1.073	0.839	0.765	0.747	0.787	0.921	0.782	0.924	0.849	0.807	0.781	0.812
1990	1.077	0.833	0.780	0.710	0.786	0.919	0.775	0.922	0.837	0.824	0.776	0.803
1991	1.079	0.825	0.901	0.729	0.770	0.894	0.767	0.915	0.815	0.822	0.786	0.797
1992	1.080	0.818	0.819	0.692	0.794	0.836	0.748	0.919	0.807	0.819	0.763	0.788
1993	1.086	0.804	0.759	0.684	0.799	0.814	0.741	0.877	0.821	0.804	0.765	0.773
1994	1.090	0.797	0.729	0.664	0.748	0.791	0.742	0.870	0.774	0.782	0.748	0.761
1995	1.093	0.792	0.655	0.658	0.733	0.877	0.726	0.854	0.790	0.784	0.750	0.752
1996	1.096	0.788	0.857	0.667	0.723	0.880	0.731	0.875	0.784	0.756	0.708	0.748
1997	1.101	0.774	0.859	0.664	0.785	0.888	0.722	0.863	0.763	0.760	0.708	.0732
1998	1.104	0.767	0.784	0.650	0.761	0.775	0.709	0.851	0.780	0.736	0.702	0.725
1999	1.108	0.758	0.742	0.615	0.753	0.735	0.694	0.820	0.760	0.723	0.686	0.713

Index of occurrence reports the ratio of the average number of births for a given day of the week to the overall average daily number of births. For example, a value of 0.713 for Sundays in 1999 indicates that births are 28.7 percent less likely to occur on Sundays. In the first two columns holidays are defined as Christmas day, Christmas eve, January 1st, December 31st, July 4th, Thanksgiving Thursday and Friday, Labor Day, Memorial Day, Super Bowl Sunday, Mother's Day, Father's Day and Presidents Day.

Table 2: Distribution of Technology of Birth and Birthweight by Day of Birth in 1998

Type of Birth	Day of Week							Total
	Sunday	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	
Panel A: Distribution of Births by Technology of Birth								
Vaginal, not induced	12.5	14.5	15.1	15.2	14.9	14.9	13.0	100.0
Vaginal, induced	8.9	14.2	17.2	16.8	16.3	15.7	10.9	100.0
Primary CS, not induced	9.4	14.8	16.6	16.3	15.9	16.5	10.5	100.0
Primary CS, induced	8.8	12.6	17.8	17.3	16.1	15.8	11.7	100.0
Repeat CS	5.3	17.3	18.1	17.2	17.0	18.8	6.3	100.0
VBAC	10.6	14.7	16.5	16.0	15.5	15.2	11.6	100.0
Total	10.5	14.6	16.2	16.0	15.6	15.6	11.6	100.0
Panel B: Distribution of Births by Day of Week								
Vaginal, not induced	58.4	48.8	45.8	46.5	46.9	46.8	54.9	49.0
Vaginal, induced	23.4	26.8	29.3	29.0	28.8	27.9	25.9	27.6
Primary CS, not induced	7.1	8.0	8.1	8.1	8.1	8.4	7.2	7.9
Primary CS, induced	3.5	3.6	4.5	4.4	4.2	4.2	4.1	4.1
Repeat CS	3.8	9.0	8.4	8.1	8.2	9.1	4.1	7.6
VBAC	3.8	3.9	3.9	3.8	3.8	3.7	3.8	3.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Panel C: Average Birthweight in grams, by Technology of Birth and Day of Week								
Vaginal, not induced	3305	3327	3335	3331	3328	3325	3309	3324
Vaginal, induced	3344	3409	3413	3400	3397	3390	3353	3391
Primary CS, not induced	3139	3219	3247	3240	3229	3230	3165	3217
Primary CS, induced	3430	3479	3498	3489	3478	3473	3456	3476
Repeat CS	3295	3437	3435	3425	3426	3432	3315	3417
VBAC	3349	3396	3404	3395	3390	3387	3359	3385
Total	3308	3359	3369	3361	3357	3354	3318	3350

Data comprises all birth certificates with non-imputed values of birth weight and gestation, and those that had valid codes for congenital anomalies, complications of labor and delivery, obstetric procedure used, and medical risk factors [n=3,734,051]. Induced births include those where labor was stimulated. A Pearson chi-squared rejected the independence of rows and columns in all panels.

Table 3: Unadjusted and adjusted (Odds Ratios) of the Probability of having a Weekday Birth in 1998

	Unadjusted Means			Adjusted OR: All Births			Adjusted OR: First Births Only		
	Weekday Births	Weekend Births	$P>\lvert z\rvert$	OR	$P>\lvert z\rvert$	[95% CI]	OR	$P>\lvert z\rvert$	[95% CI]
Birth Order- Second Birth	32.9%	30.8%	0.000	1.14	0.000	[1.14 -1.15]			
Third Birth	16.4%	14.9%	0.000	1.18	0.000	[1.17 -1.19]			
Fourth Birth or Higher	10.2%	10.0%	0.000	1.13	0.000	[1.12 -1.14]			
Birthweight- < 1500gms	1.0%	1.3%	0.000	0.90	0.000	[0.87 -0.92]	0.94	0.000	[0.90 -0.97]
1500-2500 gms	4.8%	5.5%	0.000	0.95	0.000	[0.94 -0.96]	0.99	0.242	[0.97 -1.01]
Mothers age	27.0	26.7	0.000	1.00	0.000	[1.00 -1.00]	1.00	0.037	[1.00 -1.00]
Mother- Black	5.2%	5.9%	0.000	0.87	0.000	[0.86 -0.88]	0.89	0.000	[0.87 -0.90]
non White, non Black	15.1%	16.7%	0.000	0.92	0.000	[0.91 -0.92]	0.94	0.000	[0.93 -0.95]
Mother's Schooling: 9-11 yrs	15.8%	17.1%	0.000	1.09	0.000	[1.08 -1.11]	1.05	0.000	[1.03 -1.07]
12 yrs	32.6%	32.3%	0.000	1.14	0.000	[1.13 -1.15]	1.08	0.000	[1.06 -1.10]
13-15 yrs	22.1%	21.2%	0.000	1.15	0.000	[1.14 -1.17]	1.09	0.000	[1.07 -1.11]
16+ yrs of school	22.6%	21.6%	0.000	1.13	0.000	[1.12 -1.15]	1.07	0.000	[1.05 -1.09]
missing	1.3%	1.4%	0.000	1.11	0.000	[1.09 -1.14]	1.08	0.000	[1.04 -1.13]
Mother is married	68.2%	65.1%	0.000	1.05	0.000	[1.04 -1.06]	1.04	0.000	[1.03 -1.05]
Prenatal care- intermediate	18.0%	19.2%	0.000	0.94	0.000	[0.93 -0.94]	0.95	0.000	[0.94 -0.96]
inadequate	5.1%	6.0%	0.000	0.86	0.000	[0.85 -0.87]	0.90	0.000	[0.88 -0.91]
not stated	3.8%	4.4%	0.000	0.87	0.000	[0.86 -0.88]	0.90	0.000	[0.88 -0.92]
Mother smoked	10.1%	10.2%	0.000	1.00	0.405	[0.99 -1.00]	1.00	0.512	[0.99 -1.02]
drank	0.7%	0.8%	0.000	0.92	0.000	[0.89 -0.94]	0.90	0.000	[0.85 -0.94]
Weight Gain- 20 lbs or less	17.8%	17.5%	0.001	1.02	0.000	[1.01 -1.03]	1.01	0.081	[1.00 -1.02]
20-30 lbs	26.5%	26.4%	0.020	0.99	0.017	[0.99 -1.00]	0.98	0.000	[0.98 -0.99]
Gestation- 35 wks or less	6.0%	7.1%	0.000	0.87	0.000	[0.86 -0.88]	0.89	0.000	[0.87 -0.90]
36-37 wks	11.2%	12.0%	0.000	0.92	0.000	[0.91 -0.92]	0.93	0.000	[0.91 -0.94]
Baby is Female	48.8%	48.8%	0.591	1.00	0.995	[1.00 -1.00]	1.00	0.398	[1.00 -1.01]
Any Risk Factor	26.6%	25.2%	0.000	1.10	0.000	[1.09 -1.10]	1.10	0.000	[1.09 -1.11]
Any Congenital Anomaly	1.4%	1.4%	0.045	1.04	0.001	[1.01 1.06]	1.03	0.034	[1.00 -1.07]

Data comprises all birth certificates with non-imputed values of birth weight and gestation, and those that had valid codes for congenital anomalies, complications of labor and delivery, obstetric procedure used, and medical risk factors. Vaginal- Induced births include those where labor was stimulated. Panels B and C are restricted to first births only where Repeat Cesarean Section or VBAC are not possible. Reference case for birth order is first birth, for birthweight is 2500 gms or more, for race is White, for schooling is 0-8 years, for prenatal care is adequate, for weight gain is 30 lbs or more, for gestation is 38 weeks or more

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